

11/2/17 "Genius is 1% inspiration and 99% perspiration." -Thomas Edison

HW: Quarter Test on Wednesday 11/8

AIM: What are higher order derivatives?

Warm Up:

- 1) What is the rate of change of position?

Velocity

- 2) What is the rate of change of velocity?

Acceleration

- 3) What is the rate of change of acceleration?

Jerk.

Higher Order Derivatives

Did you realize that it is possible to take the derivative of a derivative? We will need this ability in the study of particle motion and objects in motion, especially related to physics in the near future.

t is time

$$s(t)$$

Position function

$$v(t) = s'(t)$$

Velocity function

$$a(t) = v'(t) = s''(t)$$

Acceleration function

First

derivative:

$$y'$$

$$f'(x)$$

$$\frac{dy}{dx}$$

$$\frac{d}{dx}[f(x)]$$

$$D_x[y]$$

Second

derivative:

$$y''$$

$$f''(x)$$

$$\frac{d^2 y}{dx^2}$$

$$\frac{d^2}{dx^2}[f(x)]$$

$$D_x^2[y]$$

Third

derivative:

$$y'''$$

$$f'''(x)$$

$$\frac{d^3 y}{dx^3}$$

$$\frac{d^3}{dx^3}[f(x)]$$

$$D_x^3[y]$$

Fourth

derivative:

$$y^{(4)}$$

$$f^{(4)}(x)$$

$$\frac{d^4 y}{dx^4}$$

$$\frac{d^4}{dx^4}[f(x)]$$

$$D_x^4[y]$$

EX #7: For each of the following, find the second derivative.

$$\text{A.) } f(x) = \frac{3}{2}x^3 + 5x^2 - 6x + 1$$

$$f'(x) = \frac{9}{2}x^2 + 10x - 6$$

$$f''(x) = 9x + 10$$

$$\text{B.) } g(x) = \frac{x^2 - 4x - 5}{x}$$

$$g'(x) = \frac{x(2x-4) - (x^2-4x-5)(1)}{x^2} = \frac{2x^2-4x-x^2+4x+5}{x^2} = \frac{x^2+5}{x^2}$$

$$g''(x) = \frac{x^2(2x) - (x^2+5)(2x)}{x^4} = \frac{2x^3-2x^3-10x}{x^4} = \frac{-10x}{x^4} = \boxed{\frac{-10}{x^3}}$$

$$\frac{7 \cancel{0} + 2}{\cancel{7}}$$

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$$C.) \quad y = \frac{x}{x+2}$$

$$y' = \frac{(x+2)(1) - x(1)}{(x+2)^2} = \frac{2}{(x+2)^2} \Rightarrow 2(x+2)^{-2}$$

$$y'' = \frac{(x+2)^2(0) - 2(2(x+2)^1(1))}{(x+2)^4}$$

$$y'' = -4(x+2)^{-3}(1)$$

$$y'' = \frac{-4}{(x+2)^3}$$

$$y'' = \frac{-4(x+2)}{(x+2)^4} = \frac{-4}{(x+2)^3}$$

$$D.) \quad f(x) = 4\sqrt{x} - \frac{6}{\sqrt{x}} = 4x^{\frac{1}{2}} - 6x^{-\frac{1}{2}}$$

$$f'(x) = 2x^{-\frac{1}{2}} + 3x^{-\frac{3}{2}}$$

$$f''(x) = -\frac{1}{2}x^{-\frac{3}{2}} - \frac{9}{2}x^{-\frac{5}{2}}$$

$$f''(x) = \frac{-1}{\sqrt{x^3}} - \frac{9}{2\sqrt{x^5}}$$